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## SHORT REPORT

# Carotid Stent Failure: Results of Surgical Rescue

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**Aim.** Little data is available on surgical “rescue” of failed carotid stents (CAS). We have analyzed a series of CAS failures treated by conventional open surgery.

**Report.** Five patients underwent surgery after CAS failure, either electively (4) or as an emergency (1). Elective surgical “rescue” was for stent restenosis (2 cases) or stent misplacement (2 cases). Emergency surgery was performed for entrapment of the protection system in the stent. Surgical rescue was accomplished by perimedial endarterectomy and “en bloc” plaque and stent extraction in 3 cases, and by vein bypass in 2 cases, with no neurological complications.

**Conclusion.** Surgical rescue of failed CAS is effective.

**Keywords:** Carotid artery; Carotid stent; Cerebrovascular disease; Cerebral ischemia; Carotid surgery.

## Introduction

There have been few reports of the outcome of surgical exploration following failed carotid artery stenting (CAS)<sup>1–7</sup> (Table 1). This publication described the outcome of a number of patients undergoing surgery following unsuccessful CAS.

## Report

Five patients were operated on for CAS failure from May 2000 to date.

### *Elective conversion*

Patient 1 was a 76 year old male who had placement of bilateral CAS 6 months earlier. He developed recurrence of symptoms due to occlusion of the right ICA and severe stenosis of the left ICA. Patient 2 was a 68 year old man who was treated with a right ICA stent for severe symptomatic stenosis. Two months

after the procedure the symptoms recurred due to a residual plaque proximally to the deployed stent (Fig. 1a).

Both these two patients were referred from other hospitals and refused a new endovascular procedure. The surgical procedure was performed in these two cases through a standard laterocervical approach. The carotid bulb was opened longitudinally, without cutting the underlying plaque, and by removing plaque and stent “en bloc” through a perimedial dissection plaque (Fig. 1b). The arteriotomy was closed either with dacron patching (case 1) or primarily (case 2).

Patient 3 was a 60 year old male who presented with in-stent restenosis 3 years after CAS placement. His original treatment was for carotid endarterectomy restenosis. Patient 4 was a 76 year old female who underwent bilateral carotid endarterectomy in 1996. She was treated with a right CAS for restenosis and now presented with symptomatic in-stent restenosis.

In these two patients the exposure was again in the standard laterocervical fashion, however surgical technique was by saphenous vein bypass to the divided distal ICA. The stent was left in place in order to avoid carotid dissection in an area of intense fibrosis.

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**Table 1. Literature review of cases of surgical rescue after stent failure**

Author	Year	N of Cases	Technique	Results
Johnson <sup>1</sup>	1997	1	Reversed saphenous vein bypass	No complication
Calvey <sup>2</sup>	1998	1	Reversed saphenous vein bypass	No complication
Reedy <sup>3</sup>	2000	2	Stent removal and EA with patch	No complication
Leger <sup>4</sup>	2001	2	PTFE bypass	No complication
Owens <sup>5</sup>	2002	6	Stent removal and EA (1) Trombolysis and stent removal with EA (1) Reversed saphenous vein bypass (2) ICA to ECA transposition	1 case of reversed vein bypass thrombosis
De Borst <sup>6</sup>	2003	4	Stent removal and EA with patch	No complication
Setacci <sup>7</sup>	2005	3	Stent removal and EA with patch (2) Thrombectomy (1)	No complication

### *Emergency conversion*

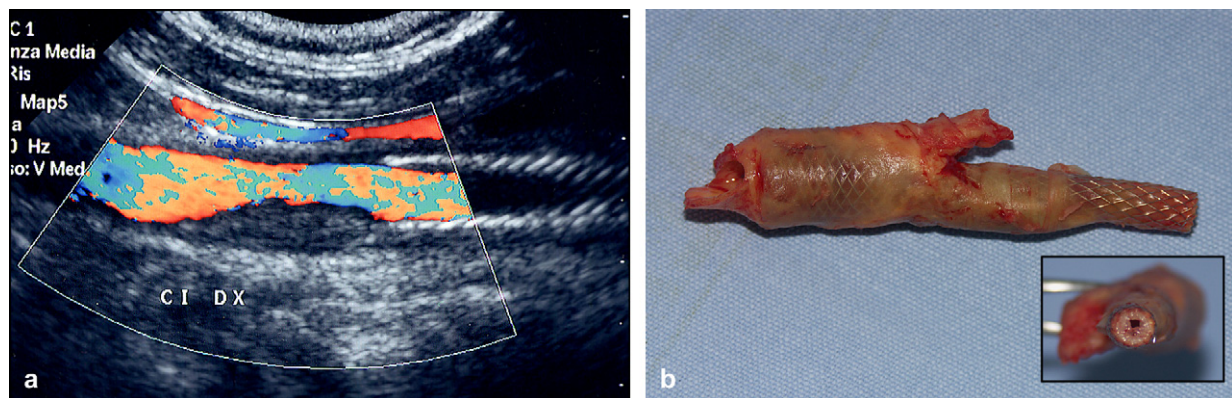
Case 5 was a 67 year old man undergoing CAS for asymptomatic carotid stenosis. The procedure was performed under local anaesthesia via common femoral artery access, with systemic anticoagulation, using a Boston Scientific 8 F 40 degrees catheter into the left common carotid, with distal protection with Guidant AccUNET filter. A Guidant Acculink 6–8 30 mm stent was deployed and post-dilatated with a 5.5 mm balloon. During the late stages of the procedure the filter retrieval catheter bumped into the inferior border of the stent with sudden recoil of the filter and entrapment into the stent structure (Fig. 2a), with initial thrombus formation. Emergency surgical conversion was performed through the usual laterocervical incision with endarterectomy as in case 1 and 2 and “en bloc removal” of the stent and of the overlying trapped filter (Fig. 2b,c,d). The filter device was surrounded by

fresh thrombi, without involvement of the distal internal carotid. Arterial closure was accomplished with dacron patching.

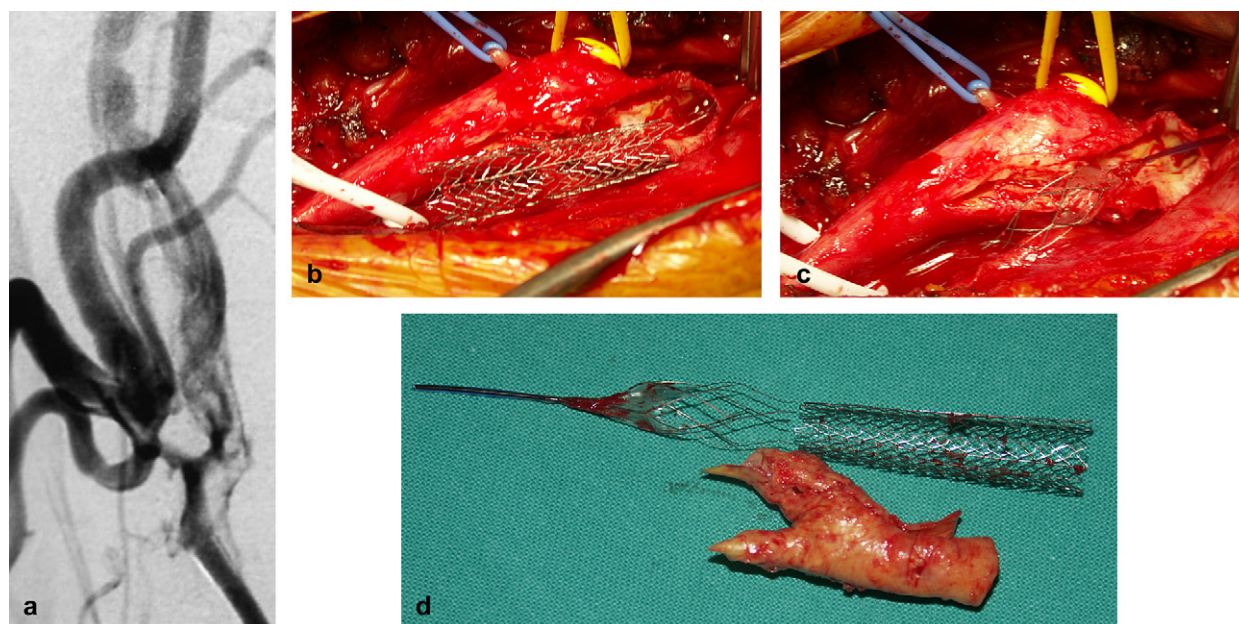
Postoperative course was uneventful in all patients reported, with no neurological complications (TIA, stroke or peripheral nerve palsy). Standard aspirin therapy (100 mg/d) was administered to all patients. Mean follow-up at  $2.3 \pm 1.2$  years did not show any significant recurrence of symptoms or restenosis.

### **Discussion**

Surgical rescue of failed CAS was achieved with success in our cases. The choice of a surgical approach rather than repetition of endovascular manoeuvres was due partly to technical consideration and also according to patient preference.



**Fig. 1.** a. Duplex imaging of uncovered plaque proximal to deployed stent. b. Intraoperative appearance of stent and plaque removed “en bloc”. The inside box shows the severe intimal hyperplasia within the stent.



**Fig. 2.** a. Initial thrombosis after filter entrapment. b. Intraoperative appearance of nitinol tapered stent and entrapped filter within the plaque. c. After stent removal, the cerebral protection system can be seen adherent to internal carotid artery. d. Intraoperative specimens of all removed materials.

In-stent restenosis may be managed by endovascular techniques according to some authors,<sup>8,9</sup> however the results obtained may be suboptimal particularly in the long-term. Surgical “rescue” is not straightforward. Fibrosis of surrounding tissues, the requirement for distal internal carotid clamping and removal of the stent may all make the procedure difficult. Saphenous vein bypass avoids dissection of the involved carotid wall, however this procedure may require isolation of a very distal segment of the internal carotid artery. Endarterectomy of the plaque together with the underlying stent may be performed through a perimedial dissection plane which should be identified without entering the carotid lumen, thus avoiding stent section and rupture. In such a way the stent may be gently extracted even from very

distal carotid segment, under direct visual control or blindly. In these cases the procedure can be carried on without distal clamping until plaque and stent removal. At that point clamping may be possible more proximally. This procedure has several advantages over vein bypass. Firstly, the embolic site is removed and there is no need to ligate the internal carotid proximal to the distal vein anastomosis. Secondly, dissection of distal internal carotid is less extensive, with minor risk of complications. Finally the operation time is shorter, with particular advantages in the emergency setting (Table 2).

The requirement for surgical “rescue” after CAS is infrequent (0.7% in our experience) however its occurrence is documented in most series<sup>1–7</sup> and needs prompt and experienced action.

**Table 2.** Summary of advantages and disadvantages of the two techniques described

Technique	Advantages	Disadvantages
Endarterectomy with stent removal	<ul style="list-style-type: none"> <li>- Complete stent and plaque removal with maintenance of carotid bifurcation anatomy</li> <li>- Possibility of avoiding very high dissection and clamping</li> <li>- Shorter operation time</li> </ul>	<ul style="list-style-type: none"> <li>- Difficult periadventitial dissection in chronic cases</li> <li>- Possibility of injury of the arterial wall</li> </ul>
Saphenous vein bypass	<ul style="list-style-type: none"> <li>- Avoidance of difficult dissection of the bulb in presence of periadventitial fibrosis</li> </ul>	<ul style="list-style-type: none"> <li>- Necessity of very distal dissection and clamping</li> <li>- Longer operation time</li> </ul>

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